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cussion of the shots threw the dust into the air, and the flame of the shots ignited it. Gunpowder is in daily use in the collieries, but usually on the working face, where there is insufficient dust to start an explosion. In every case but one, however, the shots causing the explosions were fired where the miners were enlarging the main roadway, and where the dust had been quietly accumulating for years. The fresh air passing these points at the times of the explosions varied from twenty-three thousand to sixty-one thousand cubic feet per minute, so that any accumulation of fire-damp was impossible. Dust in the air may be ignited by an open light, but not by a safety-lamp. One of the curious features of the dust-explosions is, that they exhibit but little force or violence near the point of origin, but seem to require a distance of from fifty to one hundred yards in which to gain headway. Once initiated, the explosion is self-propagating, and rapidly increases in violence; the normal condition, after an explosion is fairly established, being (1) a wave of air preceding the explosion and filling the air in the roads with coal-dust, (2) flame following instantly into compressed air charged with dust.

Various popular ideas about explosions, such as that they 'face the wind' or travel against the fresh air, favor the coal-dust theory.

Under the head of remedial measures, the authors of the report note that watering the roadways, which has been practised for many years as a mere matter of convenience, is of little avail as a means of preventing explosions, since the upper dust in every instance is left undisturbed. Gunpowder should not be used in dusty places without first thoroughly dampening the dust. The accumulation of dust in the roads may be diminished by reducing the velocity of the air, which can be done by enlarging or doubling the roads; by reducing the speed of the coal-cars; or by wetting or covering the loaded cars. Extensive dust-explosions could be prevented by keeping occasional sections of the roads thoroughly wet.

Since the dryness of the mines is due mainly to their high temperatures, a large volume of air entering at 40°, and raised in its course to 70°, exercising an enormous drying power, the following more drastic remedy is also suggested: to raise the air entering the mine to the temperature of the mine, and saturate it with moisture. It could then exercise no drying power, and the natural moisture of the mine would come into play, changing dry mines to damp mines. The principal objections to this plan are the expense, and the greater discomfort to the miners of working in warm, moist air.

A more recent contribution in the Proceedings

of the Yorkshire geologic and polytechnic society, for 1886, recognizes the great importance of coal-dust in colliery explosions, and shows, that, contrary to the generally accepted theory, important explosions are much more likely to occur when the barometer is high than when it is low. The explanation is, that, while a high or rising barometer tends to prevent the escape of gas from the coal, it is also usually accompanied by a dry atmosphere, which renders the coal-dust lighter and more inflammable.

ELECTRIC RAILROADS IN THIS COUNTRY.

AN interesting article on electric railroads in the United States, by T. C. Martin, appeared in a recent issue of the *Railroad Gazette*. The progress already made in the application of electric energy as a motive power for street-railroads, as reviewed in Mr. Martin's article, cannot fail to be encouraging to all engaged in the development and exploitation of inventions in that particular field of industry. Nor is it without interest to scientific men and the public generally. One electric road in Baltimore, equipped by the Daft company, has been in successful and profitable operation about two years. A road in Los Angeles, Cal., built by the same company, has been running several months, and is soon to be extended to nearly double its present length. This company is also constructing and equipping electric railroads in Pittsburgh, Penn., and Orange, N.J., and will construct others at Mansfield, O., and Ithaca, N.Y.

The Van Depoele company of Chicago is able to show a good record in the matter of electric-railroad construction. Roads using its system of electric propulsion are running at Port Huron and Detroit, Mich.; Appleton, Wis.; Windsor, Ont.; Scranton, Penn.; and Montgomery, Ala.; which last-named city has eleven miles of road in operation. This company is now constructing roads at Lima, O., and Binghamton, N.Y.

In Denver, Col., there is an electric road, constructed on what is known as the Short-Nesmith system, in which the current conductor runs in an underground tube, contact being effected through a five-eighths inch slot between the rails. This road crosses eight horse-car tracks, five steam-car tracks, and a two-hundred-foot bridge.

A three-mile road in Detroit uses the Fisher system of equipment, and a short line in Pittsburgh is being equipped on the same system. A nine-mile section of road in San Diego, Cal., intended for high speed, will be constructed by a company which has just completed a double-track road in Kansas City. These two are overhead conductor roads. A Philadelphia company, which

has already constructed a short line in that city, is at present busy on the construction of mining roads; one of these, now under way, being six thousand feet long, and wholly in the mine. The Sprague company of this city has completed a short road for a Boston sugar-refinery, and is now making estimates for street-lines in several of our larger cities. This company has made a series of tests with storage-batteries for street-car purposes, which have given very satisfactory results.

A cross-town line in this city is to be equipped with the Bentley-Knight conduit system, — a system specially devised to meet the requirements of street-car traffic in crowded city streets. A road in Allegheny City, Penn., is contracted for by the Bentley-Knight company. On the Eighth Avenue road in this city, and also on a road in St. Louis, the Julian storage-battery system has been tried, and, it is claimed, with results showing economic features as compared with horse-traction.

After referring to the many systems still in the purely experimental stage, Mr. Martin concludes as follows: "At Ansonia, Conn., an electric road, three and a half miles long, from Derby to Birmingham and Ansonia, using overhead wire, has been contracted for. It will be used for both freight and passengers, and power to drive the dynamo will be taken from the Housatonic dam. At Newton, Mass., a road is to be built by a company already formed; one is proposed for Worcester, Mass. At Brookline, Mass., two will soon be in operation, and one each is in view at Bangor and Biddeford, Me. Two roads are contemplated in Brooklyn, one at Coney Island, and one at Rockaway. Pelham Park, N.Y., is to have a road this summer, and Asbury Park, N.J., is advertising for bids on another. Franchises are asked for a road in Jersey City and Bayonne; and Plainfield, N.J., is also wanting a road. In Pennsylvania, Scranton, with one successful road, is to have another, and probably two. A road is to be built from Carbondale to Jermyn, four miles. In Reading, the Perkiomen Avenue company proposes to adopt electricity. Harrisburg is to have a road, and it looks as though, before the end of the year, Pittsburgh will have half a dozen. Down south, steps have been taken to construct new electric roads, or adopt the system on old roads, in Jacksonville, Fla.; Pensacola, Fla.; Birmingham, Ala.; Selma, Ala.; Atlanta, Ga.; and Fort Smith, Ark. Among roads spoken of in Ohio are several at Cincinnati, Cleveland, Tiffin, and other places. Wichita, Kan., is proposing to adopt electricity for its street-cars. Lincoln, Neb., has formed a company to operate an electric railway from the business part of the town to the stock-yards. In San Francisco a road is to be

built on Fillmore Street hill, and roads are also wanted at San Jose and Riverside, San Bernardino county. If I were at liberty to do so, I could add to the above list about fifty names of places where, from present indications and movements, it is safe to say that electric roads will be running within a year."

EXPLORATION AND TRAVEL.

Sierra Leone.

WE give elsewhere a brief sketch of the tribes of Sierra Leone. Our knowledge of this country is principally due to the commercial companies which are established on the coast, and to the endeavors of the English and French to extend their colonies towards the interior. We find some very interesting notes on Sierra Leone in letters by Lieutenant Mathews, which were published in 1791; and his descriptions of the people are still true, though a long time has elapsed, and the slave trade was long since abolished. The first to enter the interior was Major Laing, who, in 1822, succeeded in reaching the sources of the Scarcies and Rockelle, the principal rivers of the colony. R. Caillié, on his journey from the Senegal to the Joliba (the upper Niger) and Timbuktu, and thence through the Sahara to Morocco, 1824-28, crossed the territory of the Mandingos, and gave an interesting description of their customs and mode of life. In 1842, W. C. Thomson explored the district north of the Scarcies River and Futa-Jalon, where the Scarcies, Gambia, and many tributaries of the Senegal and Niger, have their sources. In 1869, Winwood Reade, who was sent out by the London geographical society, explored the country between the Scarcies and Rockelle rivers, and after having reached the town of Falaba, Major Laing's farthest point, crossed the watershed and descended the Niger, which he followed a long distance. The latest important researches are those of E. W. Blyden, who travelled in the Susu country, north of the Scarcies, in 1872, and of J. Zweifel and M. Moustier, who were sent out by the French merchant Verminck for the purpose of discovering the source of the Niger (1879). They followed Reade's route as far as Falaba, and then turned south to the head waters of the Niger. Most of these routes run parallel to the large rivers. The tributaries which are crossed by these routes are little known, and much work remains to be done before the geographical features of the country and the ethnological character of its inhabitants will be tolerably well known.

The proposed French expeditions to the upper Niger will add considerably to our present knowledge of the interior parts of this district. Owing